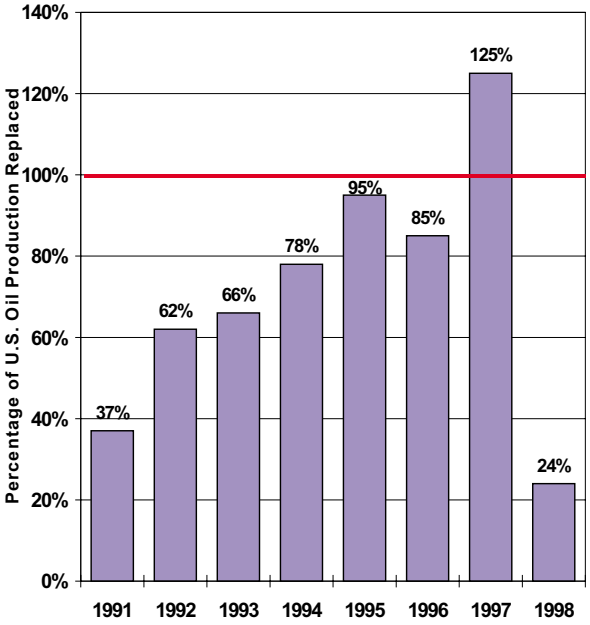
3. Crude Oil Statistics

The United States had 21,034 million barrels of crude oil proved reserves as of December 31, 1998. This is 7 percent (-1,512 million barrels) less than in 1997, and is the largest percentage decline in oil reserves in 53 years. *Reserves additions* of crude oil were less than a fifth of those in 1997—operators only replaced 24 percent of 1998 oil production (**Figure 15**). Crude oil prices, which began a decline in 1997, fell dramatically during 1998 to levels last seen in 1935 by December. Low prices curtailed new drilling and imposed negative revisions on producing oil fields, which resulted in the large drop in crude oil proved reserves in 1998.

Figure 15. Reserve Additions Replace Only 24 Percent of U.S. Oil Production in 1998



Source: Energy Information Administration, Office of Oil and Gas.

Over the past decade, U.S. crude oil proved reserves had been declining (**Figure 1**) an average of 2 percent per year. However, less new reserve additions and more negative revisions made the decline much more severe in 1998. As of December 1999, prices have rebounded—yet oil well drilling has yet to resume at the pace observed in the last decade. If drilling resumes, it is expected that the 2 percent declining trend will reestablish itself in the future. In the absence of that needed drilling, declines will be higher as the reserves base depletes through production.

Proved Reserves

Table 6 presents the U.S. proved reserves of crude oil as of December 31, 1998, by selected States and State subdivisions.

Figure 16 maps 1998 crude oil proved reserves by area. The following four areas account for 79 percent of U.S. crude oil proved reserves:

Area	Percent of U.S. Oil Reserves
Alaska	24
Texas	23
California	18
Gulf of Mexico Federal Offshore	13
Area Total	**79**

Of these four areas, California increased its reserves in 1998, while Alaska, the Gulf of Mexico, and Texas all had decreases in crude oil proved reserves.

Discussion of Reserves Changes

Figure 17 maps the change in crude oil proved reserves from 1997 to 1998 by area. Here's how the top four areas fared compared to the total United States:

Area	Change in U.S. Oil Reserves (million barrels)
Texas	-760
Alaska	-109
California	+93
Gulf of Mexico Federal Offshore	-156
Area Total	**-932**
U.S. Total	**-1,512**

Figure 2 in Chapter 2 shows the components of the changes in crude oil proved reserves for 1998 and the preceding 10 years.

Table 6. Crude Oil Proved Reserves, Reserves Changes, and Production, 1998

(Million Barrels of 42 U.S. Gallons)

State and Subdivision	Published Proved Reserves 12/31/97	Changes in Reserves During 1998							Proved Reserves 12/31/98
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (--)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	5,161	1	267	64	28	96	0	437	5,052
Lower 48 States	**17,385**	**-639**	**2,485**	**2,170**	**299**	**56**	**120**	**1,554**	**15,982**
Alabama	47	2	6	9	0	0	0	7	39
Arkansas	45	-1	24	14	0	0	0	7	47
California	3,750	-131	789	336	23	0	18	270	3,843
Coastal Region Onshore	430	-33	62	86	0	0	0	19	354
Los Angeles Basin Onshore	268	-39	19	42	0	0	18	17	207
San Joaquin Basin Onshore	2,871	-58	708	204	23	0	0	213	3,127
State Offshore	181	-1	0	4	0	0	0	21	155
Colorado	198	17	37	21	1	0	0	20	212
Florida	91	-1	0	13	0	0	0	6	71
Illinois	92	-25	56	32	0	0	0	10	81
Indiana	10	-4	12	4	0	0	0	[b]1	[b]13
Kansas	238	28	85	77	5	1	0	34	[b]246
Kentucky	20	9	0	4	0	0	0	2	23
Louisiana	714	-81	180	208	17	3	9	83	551
North	136	11	31	62	3	0	0	18	101
South Onshore	427	-58	139	129	14	2	6	48	353
State Offshore	151	-34	10	17	0	1	3	17	97
Michigan	68	-5	8	19	0	0	0	8	44
Mississippi	183	20	13	65	9	0	0	19	141
Montana	159	-11	30	13	15	1	0	14	167
Nebraska	21	2	4	6	0	0	0	3	18
New Mexico	735	-36	79	126	23	0	4	59	620
East	719	-33	78	123	23	0	4	58	610
West	16	-3	1	3	0	0	0	1	10
North Dakota	279	-29	33	21	16	0	0	33	245
Ohio	43	0	9	6	0	0	0	6	40
Oklahoma	605	-62	207	106	16	1	0	62	599
Pennsylvania	17	-2	1	2	2	0	0	1	15
Texas	5,687	-295	514	621	48	2	9	417	4,927
RRC District 1	83	-18	35	32	1	0	0	8	[b]61
RRC District 2 Onshore	66	-22	16	8	0	0	0	7	45
RRC District 3 Onshore	259	-11	45	56	9	0	0	35	211
RRC District 4 Onshore	70	-23	6	7	0	0	0	6	40
RRC District 5	54	-23	19	8	1	0	5	8	40
RRC District 6	348	-13	19	15	1	0	0	32	308
RRC District 7B	155	-21	16	21	1	0	0	15	115
RRC District 7C	227	-37	19	22	3	1	0	18	173
RRC District 8	2,100	-58	129	192	20	1	3	138	1,865
RRC District 8A	2,098	-40	173	219	10	0	0	127	1,895
RRC District 9	144	-25	21	15	1	0	1	16	111
RRC District 10	79	-1	15	25	1	0	0	[b]7	[b]62
State Offshore	4	-3	1	1	0	0	0	0	1
Utah	234	-9	10	21	1	0	0	14	201
West Virginia	26	0	1	9	0	0	0	1	17
Wyoming	627	-2	46	98	31	1	0	58	547
Federal Offshore	3,477	-22	340	336	92	47	80	417	3,261
Pacific (California)	528	-16	33	42	5	0	5	45	468
Gulf of Mexico (Louisiana)	2,587	15	275	263	84	47	74	336	2,483
Gulf of Mexico (Texas)	362	-21	32	31	3	0	1	36	310
Miscellaneous[a]	19	-1	1	3	0	0	0	2	14
U.S. Total	**22,546**	**-638**	**2,752**	**2,234**	**327**	**152**	**120**	**1,991**	**21,034**

[a]Includes Arizona, Missouri, Nevada, New York, South Dakota, Tennessee, and Virginia.

[b]Indicates the estimate is associated with a sampling error (95 percent confidence interval) that exceeds 20 percent of the estimated value.

Note: The production estimates in this table are based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves." They may differ from the official Energy Information Administration production data for crude oil for 1998 contained in the *Petroleum Supply Annual 1998*, DOE/EIA-0340(98).

Source: Energy Information Administration, Office of Oil and Gas.

Figure 16. 1998 Crude Oil Proved Reserves by Area

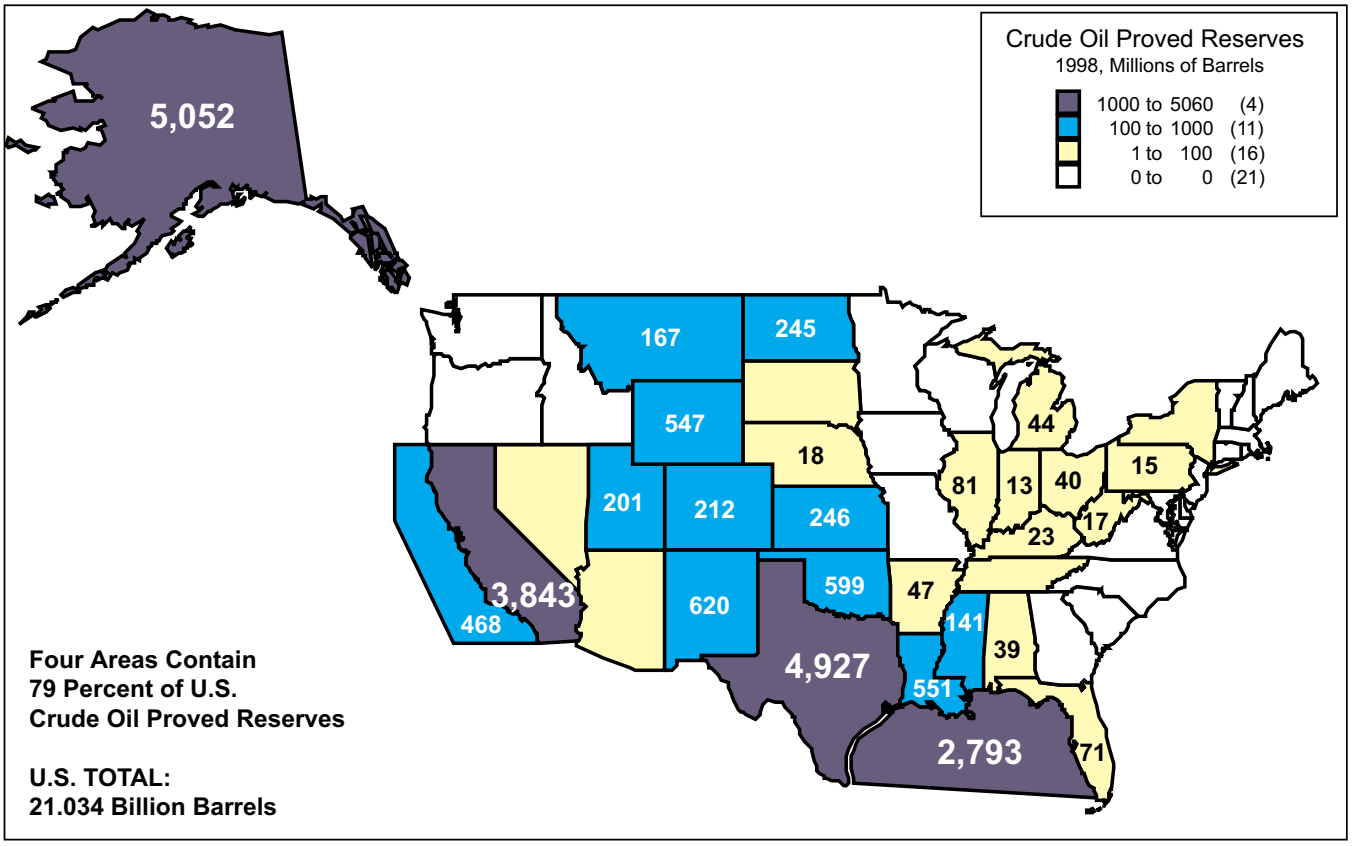
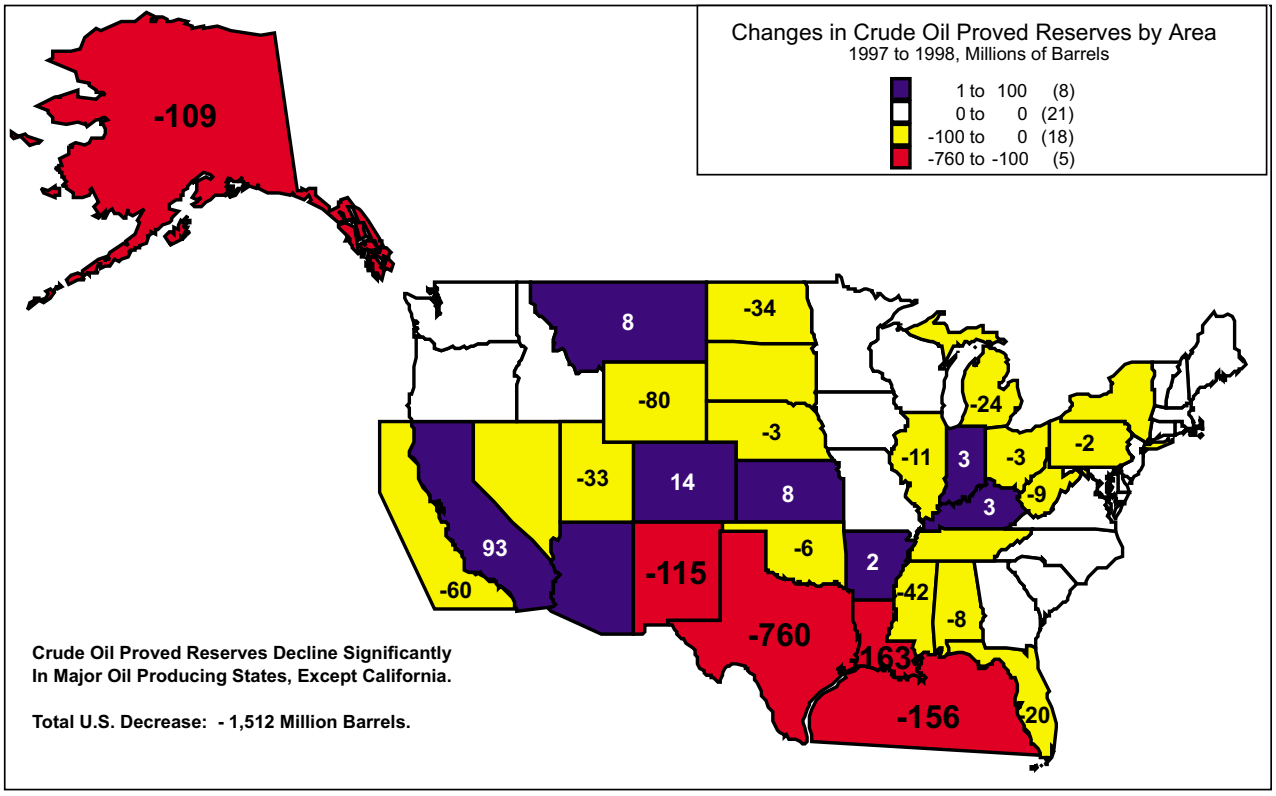


Figure 17. Changes in Crude Oil Proved Reserves by Area, 1997 to 1998



Source: Energy Information Administration, Office of Oil and Gas.

Total Discoveries

Total discoveries are those new reserves attributable to *extensions* of existing fields, *new field discoveries*, and *new reservoir discoveries in old fields*. They result from the drilling of exploratory wells.

Total discoveries of crude oil were 599 million barrels in 1998, less than half those of 1997. Only five areas had *total discoveries* exceeding 30 million barrels:

- The Gulf of Mexico Federal Offshore had 209 million barrels of *total discoveries*, 35 percent of the National total.
- Alaska had 124 million barrels of *total discoveries*, 21 percent of the National total.
- Texas had 59 million barrels of *total discoveries*, 10 percent of the National total.
- California had 41 million barrels of *total discoveries*, 7 percent of the National total.
- Wyoming had 32 million barrels of *total discoveries*, 5 percent of the National total.

The United States discovered an average of 747 million barrels of new crude oil proved reserves per year in the prior 10 years (1988 through 1997). *Total discoveries* in 1998 were 20 percent less than that average.

Extensions

Operators reported 327 million barrels of *extensions* in 1998. The highest volume of *extensions* was reported in the Gulf of Mexico Federal Offshore (87 million barrels of *extensions*.) Operators in Texas reported 48 million barrels of *extensions*. Wyoming was third with 31 million barrels, followed by Alaska with 28 million barrels.

In the prior 10 years, U.S. operators reported an average of 435 million barrels of *extensions* per year. The 1998 *extensions* were 25 percent less than that average.

New Field Discoveries

There were 152 million barrels of *new field discoveries* reported in 1998. Only eight areas in the United States reported any *new field discoveries*, and only two contributed more than 2 percent to the total:

- Alaska (63 percent; 96 million barrels)
- Gulf of Mexico Federal Offshore (31 percent; 47 million barrels).

In the prior 10 years, U.S. operators reported an average of 176 million barrels of reserves from *new field discoveries* per year. Reserves from *new field discoveries* in 1998 were 14 percent less than that average volume.

New Reservoir Discoveries in Old Fields

Operators in the United States reported 120 million barrels of crude oil reserves from *new reservoir discoveries in old fields* in 1998. As with *new field discoveries*, the most significant portion of the *new reservoir discoveries in old fields* came from the Gulf of Mexico Federal Offshore—75 million barrels or 63 percent of the total. California had 18 million barrels (15 percent), and Louisiana and Texas each had 9 million barrels (8 percent each). In the prior 10 years, U.S. operators reported an average of 135 million barrels of reserves from *new reservoir discoveries in old fields* per year. Reserves from *new reservoir discoveries in old fields* in 1998 were 89 percent of that average.

Revisions and Adjustments

Thousands of positive and negative *revisions* to proved reserves occur each year as infill wells are drilled, well performance is analyzed, new technology is applied, or economic conditions change. *Adjustments* are the annual changes in the published reserve estimates that cannot be directly attributed to the estimates for other reserve change categories because of the survey and statistical estimation methods employed.

There were -120 million barrels of net *revisions and adjustments* for crude oil in 1998. This was the first time in 22 years that revisions and adjustments did not make a positive contribution to oil reserve additions. Average *revisions and adjustments* for the prior 10 years were 1,181 million barrels.

Production

U.S. *production* of crude oil in 1998 was 1,991 million barrels. This was 7 percent lower than 1997's total of 2,138 million barrels. U.S. crude oil *production* has declined in 12 of the last 13 years. Alaska and Texas are still the largest producers of crude oil in the United States with 22 percent and 21 percent of the total, respectively. The Gulf of Mexico Federal Offshore is third with 19 percent, and California has 14 percent.

In 1998, the Form EIA-23 National production estimates were 5 percent lower than the comparable *Petroleum Supply Annual (PSA) 1998* volumes for crude

oil and lease condensate combined. There were over a thousand significant oil and gas field sales in 1998 reviewed by EIA as part of our quality assurance program. Often, new operators of a field acquired through purchase correctly reported their new proved reserves on Form EIA-23, but then reported only their 1998 production since assuming ownership – which may leave out several months of production from their reported annual total for a field. The net effect of this was a larger than usual difference between the total oil production reported on Form EIA-23 and the annual production reported in the *PSA 1998*.

Areas of Note: Large Discoveries and Reserves Additions

The following State and area discussions summarize notable activities during 1998 concerning expected new field reserves, development plans, and possible production rates as reported in various trade publications. The citations do not necessarily reflect EIA's concurrence, but are considered important enough to be brought to the reader's attention.

The following areas are the major success stories for crude oil reserves and production for 1998.

California

California's proved oil reserves increased by 93 million barrels in 1998. The largest increase was from revisions and adjustments in the San Joaquin Basin Onshore, home of California's "heavy oil" fields. This area's reserves increased by 256 million barrels. California's production declined by about 5 percent from 1997's level of 285 million barrels. Reserves additions would have been even smaller in the U.S., had not certain operators (particularly those in California) continued to develop large, long-term projects despite low oil prices.

On February 5, 1998, following a ruling by a federal judge denying a request from environmentalists and Native Americans seeking to block the sale of the Elk Hills Naval Petroleum Reserve, the U.S. Department of Energy formally transferred ownership of the reserve to Occidental Petroleum Corporation. Occidental purchased a 78 percent interest in the field for $3.65 billion. Chevron Corporation currently holds the remaining 22 percent.{33}

Colorado

Colorado had the second highest net increase in crude oil proved reserves in 1998, an increase of 14 million barrels. Operators in Colorado, through acquisitions or field development, revised their crude oil proved reserves upward, and when combined with adjustments the total volume exceeded production in 1998. Colorado had an estimated 20 million barrels of oil production in 1998, which is 5 percent lower than 1997's production (21 million barrels).

Alaska

Alaska reported 124 million barrels of *total discoveries* of crude oil proved reserves in 1998—the second highest total discoveries in the United States (following the Gulf of Mexico Federal Offshore). Alaska led the nation in *new field discoveries* with a volume of 96 million barrels. The new field discoveries were made on the North Slope in "satellite fields", meaning that they are located next to large, existing Alaskan North Slope fields and can be developed economically by extending facilities from the existing production sites to reach them.

For example, in 1998, BP Exporation (now BP Amoco) began commercial production from Badami, a "satellite field" discovery on the North Slope. Badami is located on the shore of Mikkelsen Bay about 35 miles east of Prudhoe Bay. BP Exploration and its partner, PetroFina S.A. (Fina) developed this field. Badami leases lie both onshore and offshore in a sandstone reservoir at a depth of about 10,000 feet. The oil pay zone thickness is estimated to be 65-115 feet. Badami was developed as a single, onshore drill site with 40 wells and stand-alone processing facilities for handling 35,000 barrels per day. Crude oil is sent to the Endicott sales oil pipeline, which delivers it to the trans-Alaska pipeline. No road was built to Badami— access is by barge, aircraft and helicopter, and in winter by ice road. Production was briefly halted at Badami in early 1999 due to challenging reservoir conditions. Production was resumed on May 1, 1999. {34}

Gulf of Mexico Federal Offshore

Despite the net loss of reserves in 1998, the Gulf of Mexico still holds much promise for future development and reserves additions, especially in deep water. In 1998, this area had the most reserves additions of *extensions* and *new reservoir discoveries in old fields*.

- **Tanzanite:** On July 29, 1998 Anadarko Petroleum announced that it had discovered oil and natural gas at the Eugene Island South Addition Block 346 in the Gulf of Mexico, located approximately 75 miles offshore Louisiana. Anadarko estimates that the Tanzanite prospect contains reserves of at least 140 million barrels of oil equivalent. On September 14, 1998, Anadarko reported its Tanzanite No. 1 well tested 21,917 barrels oer day of oil and 29.7 million cubic feet per day of natural gas.{35}

- **Angus, Europa, Macaroni:** On March 19, 1998, Shell Exploration and Production Company announced it would spend $1 billion developing the Angus, Europa, and Macaroni oil and gas discoveries located in the Gulf of Mexico. Shell expects the Angus development can yield 40,000 barrels of oil per day and 60 million cubic feet of gas per day by the end of 1999. The Europa development is expected to produce 60,000 barrels of oil per day and 45 million cubic feet of gas per day by early 2001. The Macaroni development is anticipated to yield 35,000 barrels of oil per day and 65 million cubic feet of gas per day by late 1999. Shell expects these three discoveries could add 300 million barrels of oil equivalent to the Gulf of Mexico's deep water inventory.{36}

- **Hoover and Diana:** On April 8, 1998, Exxon Corporation and British Petroleum (now BP Amoco) announced that they will spend $1.2 billion developing the Hoover and Diana oil and gas fields, located south of Galveston, Texas, in the Gulf of Mexico. Exxon estimates the fields could contain recoverable reserves of more than 300 million oil-equivalent barrels, and production is estimated to begin by 2000. Exxon holds a 66.7 percent operating interest in the project, with British Petroleum holding the remaining 33.3 percent interest.{37}

Other Gain Areas

Montana: Montana's proved oil reserves increased by 5 percent (8 million barrels).

Kansas: Kansas' proved oil reserves increased by 3 percent (8 million barrels).

Areas of Note: Large Reserves Declines

The following areas had large declines in crude oil proved reserves due to downward revisions or unreplaced production.

Texas

Texas' proved oil reserves declined by 760 million barrels in 1998, the largest decline for any State. Crude oil proved reserves in this State were revised and adjusted downward by 402 million barrels in 1998. Texas' production also declined about 12 percent from 1997 levels.

Of Texas' many districts, the largest reserves decline (235 million barrels) was in RRC District 8. Ironically, RRC District 8 is also where the most *total discoveries* of crude oil proved reserves were made in Texas in 1998 (24 million barrels)—but this volume was meager compared to the negative double-whammy of a net downward revision of 121 million barrels and production of another 138 million barrels. Other areas where oil reserves significantly decreased were RRC District 8A (203 million barrels) and RRC District 7C (54 million barrels). Not one RRC District in Texas reported an increase in crude oil proved reserves in 1998.

Louisiana

Louisiana's proved oil reserves decreased by 163 million barrels. The South Onshore region of Lousiana reported almost half of the loss. Louisiana's production also decreased 17 percent from 1997's level.

Gulf of Mexico Federal Offshore

There was a net loss of 156 million barrels of crude oil proved reserves from the Gulf of Mexico Federal Offshore in 1998. Gulf oil reserves had been increasing for 6 years in a row—1998's decline interrupts this trend. It is expected that development and exploration in the Gulf of Mexico Federal Offshore will continue to add future reserves, making 1998's decline merely an economic "pothole" in the road of developing the Gulf's great resource base.

The Gulf of Mexico produced about 372 million barrels of crude oil in 1998, an increase of 9 percent (30 million barrels) over 1997's production. However, there were only 216 million barrels of total reserves additions

(which includes adjustments, net revisions, and total discoveries) in this area, which replaced just 58 percent of production from this area.

New Mexico

New Mexico's proved oil reserves decreased by 115 million barrels. The East region of New Mexico reported the bulk of the loss. New Mexico's production also decreased 7 percent from 1997's level.

Alaska

Alaska's crude oil proved reserves declined 109 million barrels in 1998, slightly less than the loss reported in 1997 (113 million barrels). Alaska had the most volume of *new field discoveries* (96 million barrels) of any State in 1998. It also had the second highest volume of net revisions and adjustments (204 million barrels). But these did not offset Alaska's oil production—an estimated 437 million barrels in 1998. Alaska's production declined 8 percent from its 1997 level.

Other Decline Areas

In the following areas of the United States, development of existing or new oil fields was outpaced by crude oil production.

Wyoming: Proved oil reserves decreased by 13 percent (80 million barrels).

Pacific Federal Offshore: Proved oil reserves decreased by 11 percent (60 million barrels). On June 12, 1998, President Clinton extended by 10 years the ban on offshore drilling for much of the United States. The extended ban prevents drilling for oil and natural gas in most parts of the Atlantic and Pacific coasts until 2012.{38}

Mississippi: Proved oil reserves decreased by 23 percent (42 million barrels).

Reserves in Nonproducing Reservoirs

Not all proved reserves of crude oil were contained in reservoirs that were producing. Operators reported 4,147 million barrels of proved reserves in nonproducing reservoirs, 10 percent more than reported in 1997 (3,755 million barrels).

Nonproducing reserves are those waiting for well workovers, drilling additional development or replacement wells, installing production or pipeline facilities, and awaiting depletion of other zones or reservoirs before recompletion in reservoirs not currently open to production.

Indicated Additional Reserves

In addition to proved reserves of crude oil, Category I and Category II operators estimate the quantities of crude oil, other than proved reserves, that may become economically recoverable from known reservoirs through the application of improved recovery techniques using currently available technology. The 1998 volume, 3,160 million barrels, is about 1 percent less than what was reported in 1997 (3,207 million barrels).

Table 7 lists the indicated additional reserves by selected States and State subdivisions. The presence of large indicated additional reserves in Alaska, California, south Louisiana and west Texas implies that significant upward revisions to proved crude oil reserves could occur in the future.

Table 7. Reported Indicated Additional Crude Oil Reserves,[a] 1998

(Million Barrels of 42 U.S. Gallons)

State and Subdivision	Indicated Additional Reserves
Alaska	832
Lower 48 States	2,328
Alabama	0
Arkansas	0
California	1,297
Coastal Region Onshore	40
Los Angeles Basin Onshore	0
San Joaquin Basin Onshore	1,257
State Offshore	0
Colorado	21
Florida	0
Illinois	0
Indiana	0
Kansas	0
Kentucky	0
Louisiana	309
North	0
South Onshore	307
State Offshore	2
Michigan	0
Mississippi	0
Montana	0
Nebraska	0
New Mexico	168
East	168
West	0
North Dakota	1
Ohio	0
Oklahoma	59
Pennsylvania	0
Texas	400
RRC District 1	0
RRC District 2 Onshore	0
RRC District 3 Onshore	28
RRC District 4 Onshore	0
RRC District 5	0
RRC District 6	<1
RRC District 7B	0
RRC District 7C	1
RRC District 8	272
RRC District 8A	99
RRC District 9	0
RRC District 10	0
State Offshore	0
Utah	56
West Virginia	0
Wyoming	10
Federal Offshore	7
Pacific (California)	0
Gulf of Mexico (Louisiana)	7
Gulf of Mexico (Texas)	0
Miscellaneous[b]	0
U.S. Total	**3,160**

[a]Includes only those operators who produced 400,000 barrels of crude oil or 2 billion cubic feet of natural gas, or both, during the report year (Category I or Category II operators).

[b]Includes Arizona, Missouri, Nevada, New York, South Dakota, Tennessee, and Virginia.

Source: Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," 1998.